Spring 2022 EE214 Experiment 7
Active RC Filters

Ahmet Akman 2442366
Yusuf Toprak Yıldıran 2444149
Assistant: Onur Selim Kılıç

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Contents

1 Introduction

In this experiment, active RC low-pass and band-pass filters will be studied. Their cut-off and center frequencies will be found manually and using the BenchVue test flow program, and frequency and phase responses will be plotted. Afterward, the passband bandwidth of the band-pass filter will be measured, and by making some adjustments to the band-pass filter circuit, its bandwidth will be increased.

2 Experimental Results and Discussion

The results of the experiment are discussed in the following steps.

2.1 Step 1

In this part, the circuit in figure 1 is set with an input sine wave of 1V peak. Then, the max output voltage is found and recorded as the center frequency by manually changing the

Student 1 : Ahmet Akman 2442366
Student 2: Yusuf Toprak Yıldıran 2444149   Date: May 29, 2022
Assistant: Onur Selim Kılıç   Group: Wednesday Morning - 5

frequency. Afterward, half-power frequency, which is equal to 0.7 times the center frequency, is found by trying the frequencies, and these values are recorded in table 1.
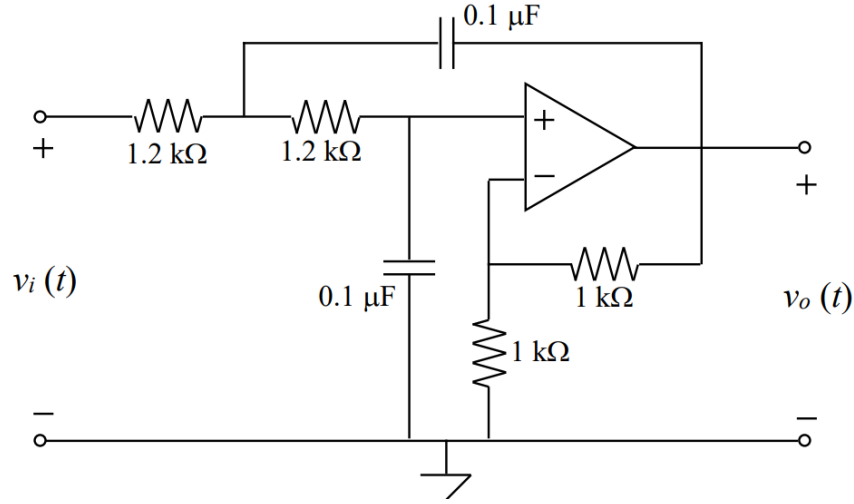

Figure 1: circuit for step 1

Table 1: Measurements

ω_c	$|H(w_c)|$	$arg(H(w_c))$
1570Hz	3.29V	107∘

ω_o	$|H(w_o)|$	$arg(H(w_o))$
900 Hz	4.7V	50∘

Afterward, frequency and phase response of the cicuit are obtained using computer BenchVue test flow with DC sweep from $\frac{f_c}{5}$ to $5f_c$ with the steps $\frac{f_c}{10}$.

After making necessary test flow settings and running the test, magnitude and frequency responses of the circuit are obtained. Then, data are exported to MATLAB, and w_0, w_1, and w_2 are determined from the magnitude response plot and shown in Figure 2.
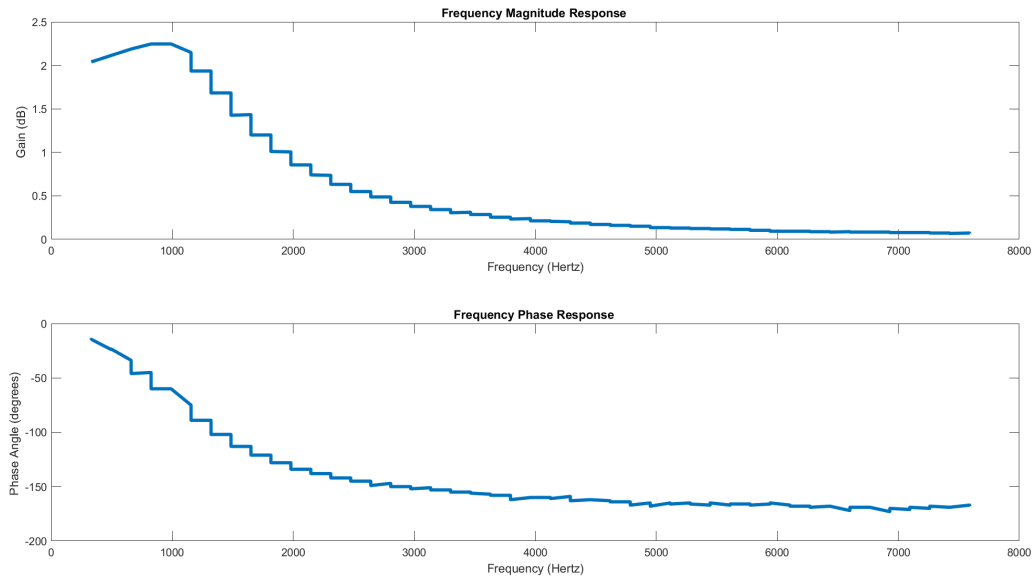
Figure 2: Magnitude and Phase response of circuit 1

2.2 Step 2

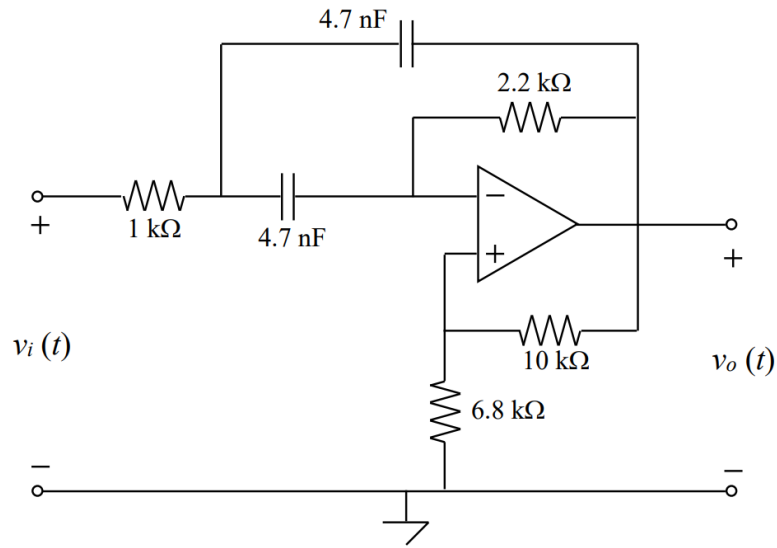In this step the band pass circuit given in Figure 3 is constructed.

Figure 3: Circuit for step 2

2.2.1 a)

The frequency magnitude and frequency phase response of the circuit is obtained and given in Figure 4.
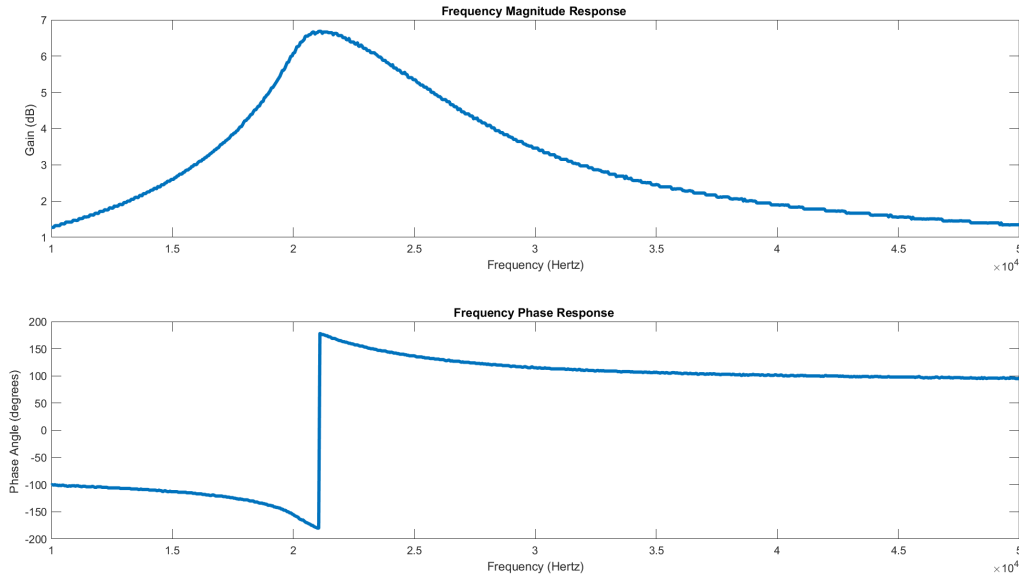
Figure 4: Magnitude and Phase response of circuit 2

So the half-power frequency, center frequency values, and the passband bandwidth is determined and given in Table 2.

Table 2: Measurements

ω_o	ω_{c1}	ω_{c2}	$\Delta\omega$
20.350 kHz	11.850 kHz	43.380kHz	31.530 kHz

It can be said that different from passive band-pass filters, active filters also have a positive gain value. This means the specified frequencies also can be amplified with an active filter.

2.2.2   b)

The resistors on the positive feedback side, a.k.a. the resistors of 6.8k and 10k, are disconnected, and the V+ terminal is grounded. As a result, the frequency magnitude and frequency phase responses are obtained and shown in Figure 5.
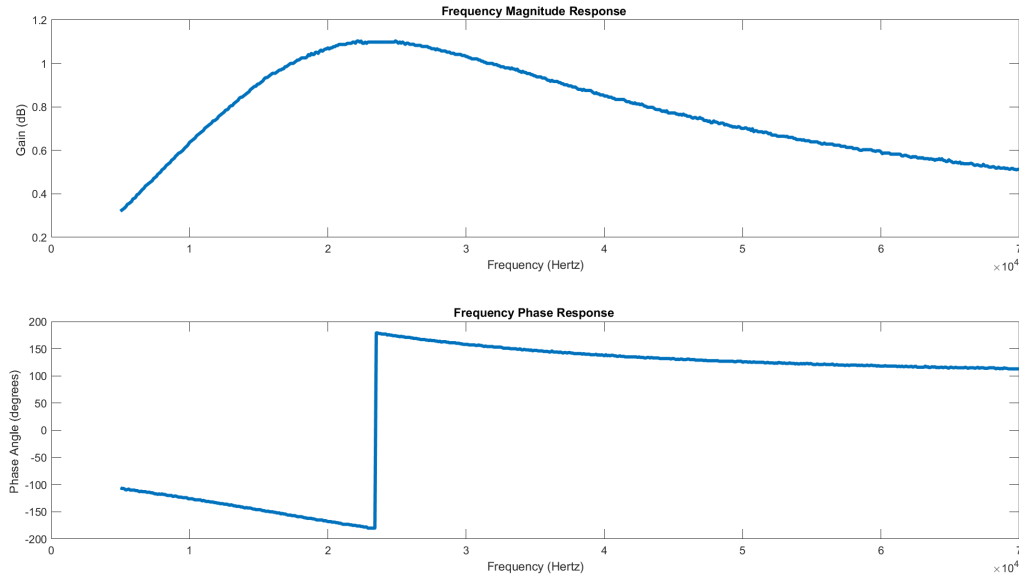
Figure 5: Magnitude and Phase response of circuit 2 without the resistors

So the half-power frequency, center frequency values, and the passband bandwidth is determined and given in Table 3.

Table 3: Measurements

ω_o	ω_{c1}	ω_{c2}	$\Delta\omega$
24.100 kHz	11.300 kHz	49.650kHz	38.350 kHz

So it can be said that even though the first half-power frequency is quite close to the first high-q setup, the second half-power frequency is different. It can be concluded that the resistors that provide feedback to the non-inverting terminal of the op-amp determine where the low pass limit takes place.

3 Conclusion

In this experiment, active RC low-pass and band-pass filters are studied. Their cut-off and center frequencies are found manually and using the BenchVue test flow program, and frequency and phase responses are plotted. Afterward, the passband bandwidth of the band-pass filter is measured, and by making some adjustments to the band-pass filter circuit, its bandwidth is increased.

Appendix A

- PreLab Preparation 2 hours

- Experimental Work 2 hours

- Report Writing 9 hours